

WHAT IS CLAIMED IS:

1. A system for indicating a position within an object, said system comprising:

reference points means in fixed relation to the object;

means for generating images of the object, said images including reference images corresponding to the reference points means;

reference means having a location outside the object;

a probe including a tip;

first means for determining the position of the tip of the probe relative to the reference means;

second means for measuring the position of the reference points means of the object relative to the reference means, whereby the position of the tip relative reference points means of the object is known;

means for translating the determined position of the tip of the probe into a coordinate system corresponding to the images of the object; and

means for displaying an image of the object which corresponds to the translated position of the tip of the probe.

2. The system of claim 1 wherein the object is a body of a patient and wherein the displaying means comprises:

means for displaying an image representing the tip of the probe on the displayed image of the body.

3. The system of claim 2 wherein the second means comprises:

a base mounted on the body in a fixed relationship with the reference points means of the body; and

5 means for measuring the position of the base with respect to the reference means.

4. The system of claim 3 wherein the reference means comprises an array having sensors and wherein the probe comprises a surgical coagulating forceps having emitters in line with the tip of the forceps and below the surgeon's line of sight when using the forceps, said emitters for communicating with the sensors of the array to indicate the position of the probe relative to the array.

5. The system of claim 4 further comprising additional emitters on the base for communicating with the sensors of the array to indicate the position of the base relative to the array.

6. The system of claim 4 further comprising a three dimensional digitizer for digitizing the signals generated by the sensors in response to the signals from the emitters.

7. The system of claim 1 wherein the translating means comprises a computer connected between the second means and the displaying means and translational software for controlling the operation of the computer so that coordinates supplied to the computer by the second means are converted
5 into corresponding coordinates supplied to the displaying means.

8. The system of claim 1 wherein the object is a body of a patient and wherein the displaying means comprises an imaging system.

9. The system of claim 1 further comprising means for compensating for temperature changes which affect the operation of the first and second determining means.

10. The system of claim 1 wherein the object is a body of a patient and wherein the displaying means comprises means for displaying on the corresponding image of the body a cursor representing the tip of the probe.

11. The system of claim 1 wherein the reference points means define a reference plane and wherein the coordinate system of the images includes an X-Y plane parallel to the reference plane.

12. The system of claim 1 wherein the object is a body of a patient, wherein the reference means comprises an array having sensors and wherein the probe comprises a surgical coagulating forceps having two emitters thereon which are in line with the tip of the forceps and below the line of sight through the forceps, said emitters for communicating with the sensors of the array to indicate the position of the probe relative to the array.

13. The system of claim 1 wherein the object is a body of a patient further comprising radiolucent pins having radiopaque tips located in the head to define the reference points means.

14. The system of claim 1 wherein the object is a body of a patient, wherein the reference points means comprises a contour surface on the head of the patient, wherein the position of the images of the head relative to the contour surface is known, and wherein the second means further comprises:

a base mounted on the head in a fixed relationship with the contour surface;

emitters mounted on the base, wherein the reference means is responsive to the emitters for determining the position of the base relative to the reference means; and

means for scanning the contour surface with a beam, wherein the reference means is responsive to the scanning beam to determine the position of the contour surface relative to the reference means.

15. The system of claim 14 wherein the reference means comprises an array having sensors and wherein the probe comprises a surgical coagulating forceps having second emitters in line with the tip of the forceps and below the surgeon's line of sight when using the forceps, said emitters for communicating with the sensors of the array to indicate the position of the probe relative to the array.

16. The system of claim 15 further comprising a three dimensional digitizer for digitizing the signals generated by the sensors in response to the signals from the first and second emitters.

17. The system of claim 14 wherein the translating means comprises a computer connected between the second means and the displaying means and translational software for controlling the operation of the computer so that coordinates supplied to the computer by the second means are converted into corresponding coordinates supplied to the displaying means.

18. The system of claim 1 wherein the object is a body of a patient and wherein the displaying means comprises:
means for displaying a plurality of images produced from a plurality of scanning technologies, wherein the displayed images correspond to the position of the tip of the probe in the body.

19. A system for relating scan images of a body of a patient, the scan images produced from first and second scanning technologies, said system comprising:

reference points means in fixed relation to the body;

means for relating the first scanned images to the reference points means;

means for relating the second scanned images to the reference points means;

means for selecting a particular first scanned image;

means for determining the position of the particular first scanned image relative to the reference points means;

means for generating a second scanned image which has the same position relative to the reference points means as the determined position, whereby the generated second

scanned image corresponds to the particular first scanned image.

20. The system of claim 19 wherein the reference points means comprises the contour of the patient's forehead and wherein the scanned images comprise scanned images of the head.

21. A method for indicating a position of a tip of a probe which is positioned within an object such as a body on images of the body wherein the body and the images of the body include reference images corresponding to a reference point, said method comprising the steps of:

determining the position of the tip of the probe relative to a reference means having a location outside the body;

determining the position of the reference points of the body relative to the reference means so that the position of the tip relative to the reference points of the body is known;

translating the determined position of the tip of the probe into a coordinate system corresponding to the images of the body; and

displaying an image of the body which corresponds to the translated position of the tip of the probe.

22. The method of claim 21 wherein the probe is a surgical probe and wherein the displaying step comprises the step of:

displaying an image representing the tip of the surgical probe on the corresponding image of the body.

23. The method of claim 21 wherein the reference means comprises an array having sensors and wherein the step of determining the position of the reference points of the body relative to the reference means comprises the steps of mounting a base on the body in a fixed spatial relationship with the reference points of the body and measuring the position of the base with respect to the array.

24. The method of claim 23 further comprising the step of emitting radiation from the base to the array to indicate the position of the base.

25. The method of claim 21 wherein the step of determining the position of the reference points of the body with respect to the reference means comprises the steps of placing the tip of the probe at the reference points and determining the position of the tip at the reference points to define the position of the reference points with respect to the reference means.

26. The method of claim 21 further comprising the step of compensating for temperature changes which affect the operation of the first and second determining steps.

27. The method of claim 21 wherein the step of determining the position of the reference points of the body relative to the reference means comprises the steps of scanning the reference points of the body with a beam and detecting the reflected beam with the reference means.

28. A system for indicating a position within a body of a patient, said system comprising:

reference points means in fixed relation to the body;

5 means for generating images of the body, said images including reference images corresponding to the reference points means;

reference means having a location outside the body; a probe including a tip;

10 first means for determining the position of the tip of the probe relative to the reference means;

second means for determining the position of the reference points means of the body relative to the reference means, whereby the position of the tip relative to the reference points means of the body is known;

15 means for translating the determined position of the tip of the probe into a coordinate system corresponding to the images of the body; and

20 means for displaying an image of the body which corresponds to the translated position of the tip of the probe.

29. A system for determining a position of an ultrasound probe relative to a part of a body of a patient, said probe being positioned adjacent to and scanning the body part, said system comprising:

5 an array positioned in communication with the probe;

first means for determining the position of the ultrasound probe relative to the array;

10 second means for determining the position of the body part relative to the array; and

means for translating the position of the ultrasound probe into a coordinate system corresponding to the position of the body part.

30. The system of claim 29 further comprising means for scanning the body part to create images thereof and means for generating an image of the body part corresponding to the planar position of the ultrasound probe.

31. The system of claim 30 wherein the scanning means comprises a CAT, PET, MRI or MEG scanner.

32. The system of claim 31 wherein the first means comprises at least three emitters on the ultrasound probe and means for activating the emitters to generate a signal communicated to the array.

33. The system of claim 29 wherein the second means comprises:

an optical scanner for scanning the body part to produce a signal received by the array indicative of the contour of a portion of the body part; and

means mounted on the body part in fixed relationship with the scanned portion of the body part for generating a signal received by the array to indicate the position of the generating means relative to the array, whereby the position of the body part relative to the array can be determined.

34. The system of claim 29 wherein the second means comprises:

an optical scanner for scanning the body part to produce a signal received by the optical scanner indicative of the contour of a portion of the body part;

means mounted on the optical scanner for emitting a signal received by the array to indicate the position of the optical scanner relative to the array; and

means mounted on the body part in fixed relationship with the scanned portion of the body part for generating a signal received by the array to indicate the position of the generating means relative to the array, whereby the position of the body part relative to the array can be determined.

35. Apparatus for indicating a position relative to a body of a patient, the apparatus comprising:

radiopaque markers; and

means for noninvasively supporting the markers on the surface of the skin.

36. The apparatus of claim 35 wherein the supporting means comprises a sheet of material overlying the body, and means on the sheet of material for supporting the markers.

37. The apparatus of claim 36 wherein the sheet of material includes apertures therein having edges for engaging the markers for supporting the markers.

38. In a scanner for scanning a body part of a patient in order to generate images representative of the body part, the improvement comprising:

means for marking the surface of the skin on the body part with a radiopaque material, whereby the generated images include images of the marking means.